

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

KIUCHI et al.

Group Art Unit:

Serial No.: New Application

Examiner:

Filed: September 28, 2001

Docket No. P107242-00023

For: POLISHING APPARATUS AND METHOD

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

September 28, 2001

Sir:

Prior to calculation of the filing fee and prior to the examination of this application, please amend the above-identified application as follows:

IN THE CLAIMS:

Please cancel original claims 1-31 and add the following claims.

-- 32. (Added) A polishing apparatus comprising:

a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and in polishing action, an amount of deformation of the polishing table in a direction normal to an upper surface thereof and/or an amount of deformation of the work holding plate in a direction normal to a work holding surface thereof is restricted to 100 μm or less.

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33. (Added) A polishing apparatus comprising:
a polishing table; and
a work holding plate,
wherein a work held on the work holding plate is polished supplying a
polishing agent solution, and the polishing table is formed in one-piece by casting, a
structure of the polishing table is such that a plurality of recesses and/or a plurality of ribs
are provided on a rear surface thereof, a flow path for a temperature adjusting fluid is
formed inside of the polishing table, and portions in each of which the flow path is not
formed act as an internal rib structure.

34. (Added) A polishing apparatus according to claim 32, wherein a value
of a thermal expansion coefficient of a material of the polishing table is $5 \times 10^{-6}/^{\circ}\text{C}$ or less
and corrosion resistance of the material is almost equal to that of stainless steel.

35. (Added) A polishing apparatus according to claim 33, wherein a value
of a thermal expansion coefficient of a material of the polishing table is $5 \times 10^{-6}/^{\circ}\text{C}$ or less
and corrosion resistance of the material is almost equal to that of stainless steel.

36. (Added) A polishing apparatus according to claim 34, wherein the
material of the polishing table is invar.

37. (Added) A polishing apparatus according to claim 35, wherein the
material of the polishing table is invar.

38. (Added) A polishing apparatus comprising:
a polishing table; and
a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and temperature changes of the polishing table and/or temperature changes of the work holding plate in polishing action are controlled within a prescribed range by controlling a flow rate and/or a temperature of a temperature adjusting fluid.

39. (Added) A polishing apparatus according to claim 38, wherein temperature changes at any position of the polishing table and/or the work holding plate in polishing action are preferably within 3°C.

40. (Added) A polishing apparatus according to claim 32, wherein temperature changes at any position of the polishing surface of the polishing cloth in polishing action are controlled to 10°C or less by controlling a temperature and/or a flow rate of the polishing agent solution.

41. (Added) A polishing apparatus according to claim 33, wherein temperature changes at any position of the polishing surface of the polishing cloth in polishing action are controlled to 10°C or less by controlling a temperature and/or a flow rate of the polishing agent solution.

42. (Added) A polishing apparatus according to claim 38, wherein temperature changes at any position of the polishing surface of the polishing cloth in polishing action are controlled to 10°C or less by controlling a temperature and/or a flow rate of the polishing agent solution.

43. (Added) A polishing apparatus according to claim 32, wherein rotational unevenness of the polishing table is restricted to 1% or less.

44. (Added) A polishing apparatus according to claim 33, wherein rotational unevenness of the polishing table is restricted to 1% or less.

45. (Added) A polishing apparatus according to claim 38, wherein rotational unevenness of the polishing table is restricted to 1% or less.

46. (Added) A polishing apparatus according to claim 32, wherein surface displacement in rotation of a polishing surface of the polishing table is restricted to 15 µm or less.

47. (Added) A polishing apparatus according to claim 33, wherein surface displacement in rotation of a polishing surface of the polishing table is restricted to 15 µm or less.

48. (Added) A polishing apparatus according to claim 38, wherein surface displacement in rotation of a polishing surface of the polishing table is restricted to 15 µm or less.

49. (Added) A polishing apparatus according to claim 32, wherein displacement in rotation of a rotary shaft of the polishing plate is restricted to 30 µm or less.

50. (Added) A polishing apparatus according to claim 33, wherein displacement in rotation of a rotary shaft of the polishing plate is table is restricted to 30 µm or less.

51. (Added) A polishing apparatus according to claim 38, wherein displacement in rotation of a rotary shaft of the polishing plate is restricted to 30 µm or less.

52. (Added) A polishing apparatus according to claim 32, wherein the work holding plate has recesses or a rib structure formed on a rear surface thereof.

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53. (Added) A polishing apparatus according to claim 33, wherein the work holding plate has recesses or a rib structure formed on a rear surface thereof.

54. (Added) A polishing apparatus according to claim 38, wherein the work holding plate has recesses or a rib structure formed on a rear surface thereof.

55. (Added) A polishing apparatus according to claim 52, wherein a material of the work holding plate is alumina ceramics or SiC.

56. (Added) A polishing apparatus according to claim 53, wherein a material of the work holding plate is alumina ceramics or SiC.

57. (Added) A polishing apparatus according to claim 54, wherein a material of the work holding plate is alumina ceramics or SiC.

58. (Added) A polishing apparatus according to claim 55, wherein a plurality of fine holes for vacuum chucking a work are opened in a region of the work holding plate where the work is adhered.

59. (Added) A polishing apparatus according to claim 56, wherein a plurality of fine holes for vacuum chucking a work are opened in a region of the work holding plate where the work is adhered.

60. (Added) A polishing apparatus according to claim 57, wherein a plurality of fine holes for vacuum chucking a work are opened in a region of the work holding plate where the work is adhered.

61. (Added) A polishing method using a polishing apparatus with a polishing table and a work holding plate, wherein a work held on the work holding plate is polished supplying a polishing agent solution, and in polishing action, an amount of deformation of the polishing table in a direction normal to an upper surface thereof and/or

an amount of deformation of the work holding plate in a direction normal to a work holding surface thereof is restricted to 100 µm or less.

62. (Added) A polishing method using a polishing apparatus with a polishing table and a work holding plate, wherein a work held on the work holding plate is polished supplying a polishing agent solution, and when a to-be-polished surface of the work is polished by a polishing cloth adhered on the polishing table, temperature changes at any position on a polishing surface of the polishing cloth in polishing action are controlled to 10° C or less.

63. (Added) A polishing method using a polishing apparatus with a polishing table and a work holding plate, wherein a work held on the work holding plate is polished supplying a polishing agent solution, and temperature changes of the work in polishing operation are restricted to 10°C or less.

64. (Added) A polishing method according to claim 62, wherein temperature changes at any position on a polishing surface of a polishing cloth and/or temperature changes of a wafer in polishing action are controlled to 10°C or less by controlling a temperature and/or a flow rate of the polishing agent solution.

65. (Added) A polishing method according to claim 63, wherein temperature changes at any position on a polishing surface of a polishing cloth and/or temperature changes of a wafer in polishing action are controlled to 10°C or less by controlling a temperature and/or a flow rate of the polishing agent solution.

66. (Added) A polishing method using a polishing apparatus a polishing table and a work holding plate, wherein a plurality of works held on the work holding plate

are polished, and the plurality of wafers are arranged and held on the work holding plate so as to satisfy a relationship expressed by the following formula (1) with errors within 2 mm:

$$R = \{(r + x) + \sin(\pi/N)(r + 2y)\}/\sin(\pi/N) \dots (1)$$

(in the above formula (1), R : a diameter of a work holding plate (mm), r : a diameter of a wafer (mm), x : a distance between two adjacent wafers (mm), y : a distance between a wafer and a peripheral edge of the work holding plate (mm), N : the number of wafers per work holding plate and π : the ratio of the circumference to its diameter.)

67. (Added) A polishing method according to claim 66, wherein r is 200 mm or more, and $5 \leq N \leq 7$, $5 \leq x \leq 20$ and $7 \leq y \leq 22$.

68. (Added) A polishing method according to claim 67, wherein a thickness d of the work holding plate is determined such that $aR < d < bR$ ($a = 0.04$ to 0.08 and $b = 0.10$ to 0.12).

69. (Added) A polishing method according to claim 61, wherein a silicon wafer is polished using a polishing apparatus comprising:

- a polishing table; and
- a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and in polishing action, an amount of deformation of the polishing table in a direction normal to an upper surface thereof and/or an amount of deformation of the work holding plate in a direction normal to a work holding surface thereof is restricted to 100 μm or less.

70. (Added) A polishing method according to claim 62, wherein a silicon wafer is polished using a polishing apparatus comprising:

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a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and in polishing action, an amount of deformation of the polishing table in a direction normal to an upper surface thereof and/or an amount of deformation of the work holding plate in a direction normal to a work holding surface thereof is restricted to 100 µm or less.

71. (Added) A polishing method according to claim 63, wherein a silicon wafer is polished using a polishing apparatus comprising:

a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and in polishing action, an amount of deformation of the polishing table in a direction normal to an upper surface thereof and/or an amount of deformation of the work holding plate in a direction normal to a work holding surface thereof is restricted to 100 µm or less.

72. (Added) A polishing method according to claim 66, wherein a silicon wafer is polished using a polishing apparatus comprising:

a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and in polishing action, an amount of deformation of the polishing table in a direction normal to an upper surface thereof and/or an amount of deformation of

the work holding plate in a direction normal to a work holding surface thereof is restricted to 100 μm or less.

73. (Added) A polishing method according to claim 61, wherein a silicon wafer is polished using a polishing apparatus comprising:

a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and the polishing table is formed in one-piece by casting, a structure of the polishing table is such that a plurality of recesses and/or a plurality of ribs are provided on a rear surface thereof, a flow path for a temperature adjusting fluid is formed inside of the polishing table, and portions in each of which the flow path is not formed act as an internal rib structure.

74. (Added) A polishing method according to claim 62, wherein a silicon wafer is polished using a polishing apparatus comprising:

a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and the polishing table is formed in one-piece by casting, a structure of the polishing table is such that a plurality of recesses and/or a plurality of ribs are provided on a rear surface thereof, a flow path for a temperature adjusting fluid is formed inside of the polishing table, and portions in each of which the flow path is not formed act as an internal rib structure.

75. (Added) A polishing method according to claim 63, wherein a silicon wafer is polished using a polishing apparatus comprising:

a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and the polishing table is formed in one-piece by casting, a structure of the polishing table is such that a plurality of recesses and/or a plurality of ribs are provided on a rear surface thereof, a flow path for a temperature adjusting fluid is formed inside of the polishing table, and portions in each of which the flow path is not formed act as an internal rib structure.

76. (Added) A polishing method according to claim 66, wherein a silicon wafer is polished using a polishing apparatus comprising:

a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and the polishing table is formed in one-piece by casting, a structure of the polishing table is such that a plurality of recesses and/or a plurality of ribs are provided on a rear surface thereof, a flow path for a temperature adjusting fluid is formed inside of the polishing table, and portions in each of which the flow path is not formed act as an internal rib structure.

77. (Added) A polishing method according to claim 61, wherein a silicon wafer is polished using a polishing apparatus comprising:

a polishing table; and

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a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and temperature changes of the polishing table and/or temperature changes of the work holding plate in polishing action are controlled within a prescribed range by controlling a flow rate and/or a temperature of a temperature adjusting fluid.

78. (Added) A polishing method according to claim 62, wherein a silicon wafer is polished using a polishing apparatus comprising:

a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and temperature changes of the polishing table and/or temperature changes of the work holding plate in polishing action are controlled within a prescribed range by controlling a flow rate and/or a temperature of a temperature adjusting fluid.

79. (Added) A polishing method according to claim 63, wherein a silicon wafer is polished using a polishing apparatus comprising:

a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and temperature changes of the polishing table and/or temperature changes of the work holding plate in polishing action are controlled within a

prescribed range by controlling a flow rate and/or a temperature of a temperature adjusting fluid.

80. (Added) A polishing method according to claim 66, wherein a silicon wafer is polished using a polishing apparatus comprising:

a polishing table; and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and temperature changes of the polishing table and/or temperature changes of the work holding plate in polishing action are controlled within a prescribed range by controlling a flow rate and/or a temperature of a temperature adjusting fluid.

81. (Added) A polishing method according to claim 69, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

82. (Added) A polishing method according to claim 70, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

83. (Added) A polishing method according to claim 71, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

84. (Added) A polishing method according to claim 72, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

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85. (Added) A polishing method according to claim 73, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

86. (Added) A polishing method according to claim 74, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

87. (Added) A polishing method according to claim 75, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

88. (Added) A polishing method according to claim 76, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

89. (Added) A polishing method according to claim 77, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

90. (Added) A polishing method according to claim 78, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

91. (Added) A polishing method according to claim 79, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

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92. (Added) A polishing method according to claim 80, wherein the polishing operation is performed in an environment where temperature changes are restricted within $\pm 2^{\circ}\text{C}$.

93. (Added) A method for adhering a work, where a work holding plate with a plurality of fine holes opened in an adhering region thereof for vacuum chucking a wafer is used and the wafer is adhered with an adhesive on the work holding plate by evacuating air through the plurality of fine holes from the rear side of the work holding plate.

94. (Added) A method according to claim 93, wherein the adhering operation is performed at a temperature in the range of 20 to 30°C.

95. (Added) A method according to claim 94, wherein the adhesive with a viscosity in the range of 1 mPa·s to 10 mPa·s at the adhering temperature is used.

96. (Added) A method according to claim 93, wherein a thickness of the adhesive in a region where the work is adhered is in the range of 0.1 μm to 0.5 μm on the average and a deviation of the thickness is 0.015 μm or less.

97. (Added) A work holding plate, wherein a plurality of suction holes for vacuum chucking a work are formed in an adhering region on a work adhering surface of the work holding plate, each of the holes penetrating from the work adhering surface of the work holding plate to a rear surface thereof.

98. (Added) A work holding plate according to claim 97, wherein recesses or a rib structure is provided on a rear surface of the work holding plate.

99. (Added) A method according to claim 93, wherein there is used a work holding plate in which a plurality of suction holes for vacuum chucking a work are formed in an adhering region on a work adhering surface of the work holding plate, each of the holes

penetrating from the work adhering surface of the work holding plate to a rear surface thereof.

100. (Added) A polishing method, wherein a silicon wafer is polished in such a state to be adhered and held on the work holding plate by means of an adhering method according to claim 93.

101. (Added) A polishing method, wherein a silicon wafer is polished in such a state to be adhered and held on the work holding plate by means of an adhering method according to claim 99.

102. (Added) A polishing method according to claim 100, wherein there is used a polishing apparatus comprising:

a polishing table and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and in polishing action, an amount of deformation of the polishing table in a direction normal to an upper surface thereof and/or an amount of deformation of the work holding plate in a direction normal to a work holding surface thereof is restricted to 100 µm or less.

103. (Added) A polishing method according to claim 100, wherein there is used a polishing apparatus comprising:

a polishing table and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and the polishing table is formed in one-piece by casting, a

structure of the polishing table is such that a plurality of recesses and/or plurality of ribs are provided on a rear surface thereof, a flow path for a temperature adjusting fluid is formed inside of the polishing table, and portions in each of which the flow path is not formed act as an internal rib structure.

104. (Added) A polishing method according to claim 100, wherein there is used a polishing apparatus comprising:

a polishing table and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and temperature changes of the polishing table and/or temperature changes of the work holding plate in polishing action are controlled within a prescribed range by controlling a flow rate and/or a temperature of a temperature adjusting fluid.

105. (Added) A polishing method according to claim 101, wherein there is used a polishing apparatus comprising:

a polishing table and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and in polishing action, an amount of deformation of the polishing table in a direction normal to an upper surface thereof and/or an amount of deformation of the work holding plate in a direction normal to a work holding surface thereof is restricted to 100 µm or less.

106. (Added) A polishing method according to claim 101

, wherein there is used a polishing apparatus comprising:

a polishing table and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and the polishing table is formed in one-piece by casting, a structure of the polishing table is such that a plurality of recesses and/or plurality of ribs are provided on a rear surface thereof, a flow path for a temperature adjusting fluid is formed inside of the polishing table, and portions in each of which the flow path is not formed act as an internal rib structure.

107. (Added) A polishing method according to claim 101, wherein there is used a polishing apparatus comprising:

a polishing table and

a work holding plate,

wherein a work held on the work holding plate is polished supplying a polishing agent solution, and temperature changes of the polishing table and/or temperature changes of the work holding plate in polishing action are controlled within a prescribed range by controlling a flow rate and/or a temperature of a temperature adjusting fluid. --

REMARKS

The above amendments to the claims have been made to correct the multiple dependency of the claims and to put the application in better condition for examination. No new matter has been added.

In the event that any fees are due in connection with this paper, please charge our Deposit Account No. 01-2300.

Respectfully submitted,

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